REMARKS

Claims 1-9 and 11-19 are pending in the present application. By this reply, claim 10 has been canceled and claims 18-19 have been added. Claims 1, 9 and 15 are independent claims.

Drawing Objection

In response to the drawing objection indicated by the Draftsperson's Form-948, attached hereto is a replacement sheet providing corrected formal Figure 9. No new matter has been added by this drawing. Accordingly, the drawing objection must be withdrawn.

The Examiner has objected to Figs. 1-5 because the Examiner states that such figures should be labeled --Prior Art-- and not "Conventional Art".

In order to address this objection, Applicant respectfully submits that the suggestion in MPEP § 608.02(g) of the use of the phrase --Prior Art-- does not exclude the use of alternate phrases, for example, "Background Art" and "Conventional Art". These alternative phrases may be found in many U.S. Patents issued today. The intent of MPEP § 608.02(g) is to distinguish Applicant's invention from that which is not Applicant's invention. If a drawing illustrates only material which is known to be statutory prior art to the invention, then the use of the phrase --Prior Art-

- in the drawings may be proper. However, if it is not clear whether such material is statutory prior art, then the use of the phrase --Prior Art-- in the drawings would be improper, but rather, a label such as "Conventional Art" would be more appropriate.

Applicant submits that the drawings including the label "Conventional Art" meet the criteria of MPEP § 608.02(g) and are sufficient to distinguish Applicant's invention from that which is not Applicant's invention. Accordingly, reconsideration and withdrawal of this objection based on these reasons are respectfully requested.

Claim Objection

Claims 3 and 17 have been objected to because of certain minor informalities. These claims and other claims have been reviewed and revised to correct minor informalities and to improve their form according to U.S. practice. Such modifications do not add any new matter to the disclosure. Accordingly, the objection to the claims should be withdrawn.

35 USC §102(b)

Claims 1, 2, 5-9, 15 and 16 have been rejected under 35 USC 102(b) as being anticipated by *Hwang et al.* (USP 5,825,726). This rejection, insofar as it pertains to the presently pending claims, is respectively traversed.

Hwang et al. is directed to a method for recording and reproducing a multi-session CD, which provides a separate total TOC (TTOC) information storage area on the disk. This TTOC information storage area is located at an outermost circumferential area of the disk. This disk further includes, in a separate area, a PMA, and a plurality of sessions including a lead-in area, a program area, and a lead-out area. The TOC information of respective sessions is recorded in the TTOC information storage area when recording is finished. *Hwang et al.* allows high-speed access to data recorded on the disk by reading out position information from the TTOC information storage area of the disk.

In contrast, Applicant's embodied invention is directed to providing a method and apparatus for accurately locating a next recordable position of a recording medium, which overcomes the limitations identified in the background section of the present specification. The present invention according to an embodiment examines an area following a next recordable position indicated by a recording position information stored in a certain lead-in area of a session, by e.g. examining whether the signal output from that area has a certain binary signal characteristic or a constant level signal characteristic. The invention thereby determines if that area contains recorded data, and updates the recording position information if the next recordable position is changed to another position on the disk based on the determination result. That is,

the present invention detects a recordable position from data recording information, and verifies the detected recordable position to see whether or not it is the last position of actually recorded data by examining the recorded state of the written data. These features, as reflected by the independent claims, are neither taught nor suggested by *Hwang et al.*

More specifically, *Hwang et al.* does not teach or suggest, *inter alia*:

> (b) examining whether or not an area after the recordable position indicated by the read data recording information has recorded data; and
> (c) determining whether to change the recordable position to another position for new input data based on the examination result

as recited in independent claim 1;

> (b) examining a recording area affected by a writing beam during the previous recording based on the searched last position result; and
> (c) determining a recordable position for new input data based on the examination result

as recited in independent claim 9; and

> a controller controlling the moving unit to move the pickup to a recordable position indicated by data recording information which was updated after a previous data recording, checking whether or not data has been recorded in an area following the indicated recordable position by examining the state of a recording surface state of the writable disk, and changing the recordable position for new data to another position based on the checked result

as recited in independent claim 15.

Accordingly, independent claims 1, 9, and 15 and their dependent due to their dependencies are patentable over *Hwang et al.*, and the rejection should be withdrawn.

35 USC §103(a) Rejection

Claims 3, 4, and 17 have been rejected under 35 USC 103(a) as being unpatentable over the art as applied to claims 1, 2, 5-9, 15 and 16 as stated above in further in view of either *Batalden et al.* (USP 4,631,706) or *Hazel et al.* (USP 4,402,061). Claims 10-14 have been rejected under 35 USC §103(a) as being unpatentable over the art as applied to claims 1, 2, 5-9, 15 and 16 as stated above and further in view of *Asthana et al.* (USP 5,623,470). These rejections insofar as they pertain to the presently pending claims, are respectfully traversed.

As discussed above, *Hwang et al.* fails to teach or suggest, *inter alia*:

> (b) examining whether or not an area after the recordable position indicated by the read data recording information has recorded data; and
> (c) determining whether to change the recordable position to another position for new input data based on the examination result

as recited in independent claim 1 from which claims 2-8 depend;

> (b) examining a recording area affected by a writing beam during the previous recording based on the searched last position result; and
> (c) determining a recordable position for new input data based on the examination result

as recited in independent claim 9 from which claims 11-14 depend; and

> a controller controlling the moving unit to move the pickup to a recordable position indicated by data recording information which was updated after a previous data recording, checking whether or not data has been recorded in an area following the indicated recordable position by examining the state of a recording surface state of the writable disk, and changing the recordable position for new data to another position based on the checked result

as recited in independent claim 15 from which claims 16 and 17 depend.

Furthermore, none of *Batalden et al.*, *Hazel et al.*, and *Asthana et al.* overcomes at least the above-identified deficiencies of *Hwang et al.* *Batalden et al.* is directed to an optical data storage system wherein the reading and writing beams share a common optical path to reduce the time required to locate the next available storage location and to read back the data at the time it is written. *Hazel et al.* provides an optical disk having reflective, dielectric and absorbing layers to establish an antireflection condition. *Asthana et al.* automatically re-records data in an area of the disk immediately following the originally recorded area when an error is detected, and thus does not teach or suggest the feature of examining whether or not an area after the recordable position indicated by the recorded information has any recorded data or examining a recorded area affected by a writing beam during the previous recording as in Applicant's invention.

Therefore, even if the references are combinable, assuming *arguendo*, the combination of references would still fail to teach or suggest the invention as recited in independent claims 1, 9, and 15 and their dependent claims due to their dependency. Accordingly, the rejections are improper and must be withdrawn.

The prior art rejections set forth in the Office Action dated December 9, 2003 merely provide a general description or background of the prior art references applied by the Examiner. They do not identify how the Examiner is equating an element/feature provided in the prior art references to Applicant's each and every feature/element recited in the claims. If the Examiner were to maintain the same or different rejection(s), the Examiner is respectfully requested to provide such correlation by identifying, e.g., reference numerals and column and line numbers from the prior art patents as required by M.P.E.P. so that Applicant can provide a more effective response to properly advance prosecution of the present application.

New Claims

Claims 18 and 19 further define the invention as recited in independent claims 1 and 15 and are patentable at least for the same reasons that their independent claims allowable as discussed above. These new claims do not add any new matter to the disclosure.

Conclusion

For the foregoing reasons and in view of the above clarifying amendments, the Examiner is respectfully requested to reconsider and withdraw all of the objections and rejections of record, and an early issuance of a Notice of Allowance is respectfully requested.

Should there be any matters which need to be resolved in the present application, the Examiner is respectfully requested to contact Esther H. Chong (Registration No. 40,953) at the telephone number of the undersigned below.

Pursuant to 37 C.F.R. § 1.17 and 1.136(a), Applicants respectfully petition a three (3) month extension of time for filing a response in connection with the present application. The required fee of $950.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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JAK/EHC/jeb
2950/0172P
Attachment(s): Substitute Specification - w/marked up copy
New Abstract
Replacement Sheet (Fig. 9)

METHOD AND APPARATUS FOR DETERMINING A RECORDABLE POSITION OF A WRITABLE DISK

BACKGROUND OF THE INVENTION

1. Field of the Invention

[001] The present invention relates to a method and apparatus for recording new data in a writable disk after a previous recording to the disk is interrupted abnormally.

2. Description of the Related Art

[002] FIG.1 is a simplified block diagram of a conventional optical disk device for recording and reproducing data to/from a writable disk such as an once-recordable disk CD-R and a rewritable disk CD-RW. The disk device of FIG.1 comprises a digital recording signal processor 4b for converting input data into recording-formatted data ~~as~~ by adding additional data such as error correction codes, a channel bit encoder 11 for converting the recording-formatted data into EFM-formatted bit stream, a writing driver 12 for yielding a writing current according to an input bit stream, an optical pickup 2 for recording signals corresponding to the writing current onto an optical disk 1 and reproducing recorded signals from the optical disk 1, an R/F unit 3 for yielding servo error signals TE and FE, and binary signals through combining the reproduced signals from the disk 1, a digital reproducing signal processor 4a for restoring original data from the binary signals, a sled motor 9 for moving the pickup 2 radially, a spindle motor 10 for rotating the disk 1, a driving unit 8 for driving the motors 9 and 10, a servo unit 5 for controlling the driving unit 8 and the pickup 2 based on the servo error signals TE and FE, a microcomputer 6 for controlling the overall operation of the servo unit 5, the digital signal processors 4a and 4b, and the writing driver 12 in order to record and reproduce data, and a memory 7 for storing data for the microcomputer 6 to use for supervising ~~operation.~~ operations.

[003] FIGS. 2 and 3 depict a recording area format and an example of recorded data for an once-recordable disk CD-R or a rewritable disk CD-RW. The writable disk is partitioned, as shown in FIG.2, into a power calibration area (PCA), a program memory area (PMA), and one or more sessions, each consisting of a lead-in area, a program area, and a lead-out area.

[004] The PCA is used for writing data experimentally to determine an optimal writing power, and the PMA is reserved for recording information such as

position and size of each recorded track which is data group recorded continuously without stop. Each track recorded in the program area is separated by a pause section which is corresponding to about 2 second reproduction time.

[005] The lead-in area has information on the next recording position, that is, a lead-in area position of the neighboring next session. Therefore, when data recording is requested, a final recording position, that is, the next recordable position is detected easily and quickly through reading the lead-in area of a last session which was closed before.

[006] FIG. 4 is a flow chart illustrating a process of writing new data adjacently to previously-recorded data. The conventional data writing method of FIG. 4 to be conducted by the disk device of FIG. 1 is described.

[007] When a user requests new data to be recorded in an inserted disk 1, the microcomputer 6 sets its mode to the recording mode (S10), conducts an optimal power calibration (OPC) ~~as~~ by recording and reproducing test data to/from the PCA, and sets an optimal writing power determined through the OPC into the writing driver 12 (S11).

[008] After that, the microcomputer 6 reads position and size information, which is recorded in the PMA, about recorded tracks (S12), and searches for the first lead-in area, the second lead-in area, and the third lead-in area, in turn based on the PMA information (S13). For example, ~~supposed~~ suppose that tracks 1 and 2 belong to the first closed session, tracks 3 and 4 belong to the second closed session, and tracks 5 and 6 are recorded next to the second closed session as shown in FIG. 5~~, the~~. The microcomputer 6 reads out position information of the second lead-in area 'LIA2' from the first lead-in area 'LIA1', and ~~knows~~ reads the second lead-in area 'LIA1' to know the next recording position, that is, the position of track 5 ~~from the second lead-in area 'LIA2'.~~

[009] Since the program area containing the tracks 5 and 6 is not closed into a session (S14), the microcomputer 6 examines the PMA information to know how many tracks are recorded in the disk 1 (S15), and locates final recorded track 6 based on the PMA information (S16). Then, the microcomputer 6 controls the digital recording signal processor 4b and the servo unit 5 to record new data on an area separated by a pause section ~~off~~ from ~~the~~ track 6. If all of the new data are recorded, the microcomputer 6 designates just-recorded data block as track 7, creates information on the recorded position and size about the track 7 and writes it in the PMA (S17).

[010] Some time later, if the tracks 5 to 7 are requested to be closed in a session (S18), the microcomputer 6 groups the tracks 5 to 7 into the third session,

writes necessary information in the secured third lead-in area 'LIA3', and secures the third lead-out area 'LOA3' next to the last track (S19). After that, the above-explained recording operation will be conducted or not according to a user's request.

[011] However, during the recording operation, a servo control may ~~be failed~~ fail due to a mechanical shock or a data buffer may be ~~underruned~~ underrun, which causes the current recording operation to stop abruptly without writing track information or lead-in information. Therefore, the PMA information may represent real-recorded tracks wrongly or the lead-in area may contain invalid information.

[012] For a writable disk ~~suffered~~ suffering from such a recording ~~fail~~ failure, it is impossible to detect the last ~~recording~~ recorded position ~~exactly, so that~~ accurately. As a result, new data may be overwritten onto previous data or unwritten area may arise between the last recorded track and the new recorded track. If previous data was overwritten by the new data, the previous data would be lost.

[013] Especially, if the writable disk is once-writable one, the new recorded data as well as the previous data are damaged together when the previous data are overwritten since the surface is burned while recording and it can not be restored to the unburned state.

SUMMARY OF THE INVENTION

[014] It is an object of the present invention to provide a method and an apparatus for determining a recordable position of a writable disk such as an once-recordable disk and a rewritable disk, which ~~detects~~ detect a recordable position from recording information, and verifies the detected recordable position to know whether or not it is the last position of actually-recorded data ~~or not~~ by examining the recorded state changed from written data.

[015] A method of determining a recordable position of a writable disk according to the present invention, reads data recording information of the writable disk, examines whether an area after a recordable position indicated by the read data recording information has recorded data or not, and changes the recordable position to ~~other~~ another position for new input data based on the examination result.

[016] Another method of determining a recordable position of a writable disk according to the present invention, checks whether a previous recording has been done ~~normally~~ properly, examines a recording area affected by a writing beam during the previous recording according to the checked result, and determines a recordable position for new input data based on the examination result.

[017] A disk recording/reproducing apparatus to which the above method according to the present invention is applied, ~~comprising~~ includes a pickup ~~of~~ for writing input data and reading the written data to/from a writable disk; a moving ~~means of~~ unit moving the pickup across the writable disk; and a controller ~~of~~ controlling the moving ~~means~~ unit to move the pickup, when recording of new data is requested, to a recordable position indicated by data recording information which was updated after a previous data recording, checking whether or not recorded data exists after the indicated recordable position ~~through~~ by examining the state of a recording surface of the writable disk, and changing the recordable position for the new data to ~~other~~ another position based on the checked result.

[018] These and other objects of the present application will become more readily apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[019] The accompanying drawings, which are included to provide a further understanding of the invention, illustrate the preferred embodiments of the invention, and together with the description, serve to explain the principles of the present invention.

[020] In the drawings:

[021] FIG.1 is a simplified block diagram of a conventional optical disk device for recording and reproducing data to/from a writable disk;

[022] FIGS. 2 and 3 depict an example of a recording area format and an example of recorded data for an once-recordable disk CD-R or a rewritable disk CD-RW;

[023] FIG. 4 is a flow chart illustrating a general process of writing new data adjacently to previously-recorded data;

[024] FIG. 5 describes an example of recorded data of a writable disk and a recording procedure ~~to~~ for the disk;

[025] FIG. 6 is a block diagram of an optical disk device to which a recordable position determining method according to the present invention is applied;

[026] FIG. 7 is a flow chart illustrating a method of determining a recordable position of a writable disk according to the present invention;

[027] FIG. 8 describes an example of recorded data and a recording procedure according to the present invention;

[028] FIG. 9 describes another example of recorded data and a recording procedure according to the present invention;

[029] FIG. 10 describes another example of recorded data and a recording procedure according to the present invention; and

[030] FIG. 11 describes another example of recorded data and a recording procedure according to the present invention.

DETAILED DESCRIPTION OF THE ~~PREFFERRED~~ PREFERRED EMBODIMENTS

[031] In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

[032] FIG. 6 is a block diagram of an optical disk device to which a recordable position determining method according to the present invention is applied. The disk device of FIG.6 comprises a digital recording signal processor 34b for converting input data into recording-formatted data ~~as~~ by adding additional data such as error correction codes, a channel bit encoder 41 for converting the recording-formatted data into EFM-formatted bit stream, a writing driver 42 for yielding a writing current according to an input bit stream, an optical pickup 32 for recording signals corresponding to the writing current onto an optical disk 1 and reproducing recorded signals from the optical disk 1, an R/F unit 33 for yielding servo error signals TE and FE, and binary signals through combining the reproduced signals from the disk 1, a digital reproducing signal processor 34a for restoring original data from the binary signals, a sled motor 39 for moving the pickup 32 radially, a spindle motor 40 for rotating the disk 1, a driving unit 38 for driving the motors 39 and 40, a servo unit 35 for controlling the driving unit 38 and the pickup 32 based on the servo error signals TE and FE, a microcomputer 36 for controlling the overall operation of the servo unit 35 and the digital signal processors 34a and 34b, and the writing driver 42 in order to record and reproduce data, and checking the reproduced EFM-formatted binary signal from the R/F unit 33 to know whether or not a corresponding area has recorded data ~~or not~~, and a memory 37 for storing data for the microcomputer 36 to use for supervising ~~operation.~~

operations. All these components are operatively coupled.

[033] FIG. 7 is a flow chart of a method of determining an actual recordable position of a writable disk according to the present invention. The method of FIG. 7

embodying the present invention to be conducted by the disk device of FIG. 6 is described in detail.

[034] When a user requests new data to be recorded in an inserted disk 1, the microcomputer 36 sets its mode to a recording mode (S30), conducts an optimal power calibration (OPC), and sets ~~an~~ the optimal writing power determined through the OPC into the writing driver 32 (S31).

[035] After the OPC, the microcomputer 36 reads position and size information, which is recorded in the PMA, about recorded tracks (S32), and searches for the first lead-in area, the second lead-in area, and the third lead-in area so forth, in turn based on the PMA information and chained information between the lead-in areas of the disk 1 (S33).

[036] For example, ~~supposed~~ suppose that tracks 1 and 2 belong to the first closed session, tracks 3 and 4 belong to the second closed session, and tracks 5 and 6 are recorded next to the second closed session as shown in FIG. 8~~, the~~. The microcomputer 36 reads out position information of the second lead-in area 'LIA2' from the first lead-in area 'LIA1', and knows the next recording position, that is, the position of track 5, from reading the second lead-in area 'LIA2'. Since the program area containing ~~the~~ tracks 5 and 6 is not closed into a session (S34), the microcomputer 36 examines the PMA information to know how many tracks are recorded ~~in~~ on the disk 1 and locates a final recorded track based on the PMA information (S35).

[037] However, if the PMA has wrong information ~~of~~ on the position and size about track 6 or has ~~not~~ no such information since a servo control malfunctioned due to an external shock or a data buffer was ~~underruned~~ underrun during recording ~~the~~ on track 6, the microcomputer 36 considers ~~the~~ track 5, which was recorded ~~normally~~ properly, as the last ~~one~~ recorded track based on the PMA information although ~~the~~ track 6 has been formed ~~in~~ on the disk 1 ~~owing~~ due to its partial recording.

[038] To prepare for such an abnormal case, the microcomputer 36 does not write new data next to ~~the~~ track 5~~, instead~~. Instead, the microcomputer 36 controls the pickup 32 to reproduce from the ending point of ~~the~~ track 5 to a certain extent. Then, the microcomputer 36 checks whether the signals outputted from the R/F unit 33 are EFM-formatted binary signals (S37). If the output is a binary signal of which state is toggled, the area following ~~the~~ track 5 is not blank~~,~~; but if not, it is blank.

[039] If the area following ~~the~~ track 5 is blank, the microcomputer 36 returns the pickup 32 to the position, which is ~~apart~~ separated from the ending point of ~~the~~ track 5 by a pause section, and controls the pickup 32 to write new

data from that new position. However, if it is determined that the area following track 5 has pre-recorded data, the microcomputer 36 continues to check the reproduced signals until it is changed to constant, that is, not binary. So that, when the transition point at which the reproduced signal is changed from binary to constant is detected, the microcomputer 36 recognizes the transition point as ~~an~~ the actual last point of recorded data belonging to uncompleted track 6 (S39).

[040] After that, the microcomputer 36 closes ~~the~~ track 5 and ~~the~~ uncompleted track 6 into a session ~~as~~ by writing necessary information in the lead-in area 'LIA3' and the lead-out area 'LOA3' after securing the lead-out area 'LOA3' (S40), and it controls new data to be written in a program area as track 7 (S38) after the just-closed session, so that the new data is not overwritten ~~in the~~ onto uncompleted track 6.

[041] Instead of closing ~~the~~ track 5 and ~~the~~ uncompleted track 6 ~~in~~ into a session as above, the microcomputer 36 may secure a pause section just after the found last recording point, and then write new data next to the secured pause section as ~~a~~ track 7.

[042] Some time later, if a session-close is requested, the microcomputer 36 closes tracks 5 and 7 and ~~the~~ uncompleted track 6 ~~in~~ into a session, and writes necessary information in the lead-in 'LIA3' and the lead-out area 'LOA3' after securing the lead-out area 'LOA3'.

[043] With the above-explained writing operation, an uncompleted track can be ~~normally~~ properly closed ~~in~~ into a session and new data is never overwritten ~~in~~ onto an uncompleted track even though the PMA information ~~is not same with~~ may not accurately reflect information on tracks recorded actually in a program area.

[044] Another example of recorded data is shown in FIG. 9 in which tracks 1 and 2 belong to the first closed session, tracks 3 and 4 belong to the second closed session, and tracks 5 and 6 are recorded next to the second closed session, and the position and size information about tracks 1 to 6 are written in the PMA~~, however~~. However, the size of the last track 6 written in the PMA is not identical to the size of actually-recorded track 6 because of momentary buffer-underrun, etc. during the recording ~~the~~ of track 6.

[045] A data writing method for the case of FIG. 9 is conducted as follows.

[046] As explained above ~~for~~ in the ~~flow~~ flowchart of FIG. 7, when a user requests new data to be recorded in an inserted disk 1, the microcomputer 36 sets its mode to a recording mode, conducts the OPC, and sets an optimal writing power determined through the OPC into the writing driver 32. After the OPC, the microcomputer 36 reads position and size information, which is recorded in the PMA, about recorded tracks, and searches for the first lead-in area, the second

lead-in area, and the third lead-in area so forth, in turn based on the PMA information and chained information between the lead-in areas. That is, the microcomputer 36 reads out position information of the second lead-in area 'LIA2' from the first lead-in area 'LIA1', and knows the next recording position, i.e., the position of track 5, from reading the second lead-in area 'LIA2'. Since the program area containing ~~the~~ tracks 5 and 6 is not closed into a session, the microcomputer 36 examines the PMA information to know how many tracks are recorded and locates the final recorded track, which will be track 6, based on the PMA information.

[047] To resolve the abnormal case in which the PMA ~~and~~ information does not accurately reflect the actual size of actually-recorded track 6 ~~are not same in size~~ due to momentary buffer underrun etc., the microcomputer 36 does not write new data after the final recording position calculated based on the PMA information ~~on the track 6, instead~~. Instead, it controls the pickup 32 to ~~reproduce~~ read from the final position ~~to~~ for a certain ~~extent~~ duration. Then, the microcomputer 36 checks whether or not the signal outputted from the R/F unit 33 is an EFM-formatted binary signal. If the output signal is binary, the area following the final recording position is not blank, but if not, it is blank.

[048] In the case that the area is not blank, when the reproduced signal makes a transition from binary to constant, the microcomputer 36 recognizes the transition point as a substantial last point of ~~the~~ track 6, and closes an area from the starting point of ~~the~~ track 5 to the recognized last point ~~in~~ into a session ~~as~~ and writing necessary information in the lead-in area 'LIA3' and the lead-out area 'LOA3' after securing the lead-out area 'LOA3'.

[049] After that, the microcomputer 36 controls and writes new data ~~to be written~~ in a program area as track 7 after the just-closed session, so that the new data is never overlapped partially with ~~the~~ track 6 of which recorded size is not identical to the size information of the PMA.

[050] Another example of recorded data is shown in FIG. 10 in which tracks 1 and 2 belong to the first closed session, tracks 3 and 4 to the second closed session, and tracks 5 and 6 to the third session, and the position and size information about tracks 1 to 6 are normally written in the PMA~~, however~~. However, the third lead-in area (LIA3) has wrong information on the next recording position or does not have ~~it~~ such information because of a mechanical shock or a buffer-underrun, etc. occurred during the closing of the third session. A data writing method for the case of FIG. 10 is ~~conducted~~ discussed as follows.

[051] As explained above ~~for~~ in the procedure of FIG. 7, when a user requests new data to be recorded in an inserted disk 1, the microcomputer 36 sets

its mode to a recording mode, conducts the OPC, and sets an optimal writing power determined through the OPC into the writing driver 32. After the OPC, the microcomputer 36 reads out position information of the second lead-in area 'LIA2' from the first lead-in area 'LIA1', reads out position information of the third lead-in area 'LIA3' from the second lead-in area 'LIA2', and tries to read out the next recording position for new data from the third lead-in area 'LIA3'.

[052] However, the reading of the third lead-in area 'LIA3' ~~fails~~ may fail due to an abnormal recorded state which was made from a servo or writing ~~fail~~ failure caused by a mechanical shock, etc. ~~Therefore~~ In such case, the microcomputer 36 controls the pickup 32 to reproduce from the starting point of the third program area next to the lead-in area 'LIA3', and checks whether the signal outputted from the R/F unit 33 is changed from EFM-formatted binary signal to a constant signal. If the output signal is changed from binary to constant and the constant level ~~maintains~~ is maintained for more than a pause period, the microcomputer 36 considers the changed position as an ending position of ~~the~~ track 6, i.e., the last track of the uncompleted session 3 and thereby knows the next actual recordable position.

[053] Then, after~~.~~

~~After~~ detecting the actual recordable position, the microcomputer 36 secures the fourth lead-in area 'LIA4', and then controls and records new data ~~to be written~~ in a program area as track 7 (S38) after the secured lead-in area 'LIA4',

[054] With the above-explained writing operation, new data is ~~normally~~ properly written in a blank area following the uncompleted session 3 even though the lead-in area of the uncompleted session 3 has abnormal data or has ~~not~~ no position information on the next ~~recording~~ recordable position.

[055] In the above case that a lead-in area is invalid, a linking session may be created as shown in FIG. 11. The linking session contains one track of null data, a lead-in area whose information points to the next recording position, that is, a lead-in area of new session 5 for new data, and a lead-out area.

[056] Therefore, the lead-in areas containing tracks which are recorded and closed in sessions normally are linked after the null session.

[057] In the explained cases that the size of a track written in the PMA is not identical to the size of an actually-recorded track and that a lead-in area has wrong or no position information on the next ~~recording~~ recordable position ~~or has not~~, the microcomputer 36 may inform a user of the abnormal condition by outputting an advisory message, and correct wrong information, if it is rewritable and correctable, according to the request of a user.

[058] The method and apparatus for determining a recordable position of a writable disk according to the present invention, ~~enables~~ enable new data not to be ~~overwritten onto~~ written over previous data of which recording was interrupted by a servo or writing ~~fail~~ failure caused from a mechanical shock, ~~thereby preventing~~ etc. This allows new data to be recorded properly as well as ~~previous~~ prevents previously written data from being damaged or lost.

[059] The invention may be embodied in other specific forms without departing from the sprit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.